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Feasibility of Shipping California Table Grapes in Fiberboard and Polystyrene Foam Boxes and in Polyethylene Mesh Bags

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Feasibility of Shipping California Table Grapes in Fiberboard and Polystyrene Foam Boxes and in Polyethylene Mesh Bags

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SUMMARY

California table grapes were packed and shipped in wood boxes, fiberboard boxes, polystyrene foam boxes of two designs, and polyethylene mesh bags in wood boxes to compare the cost of using them and to find out the advantages and disadvantages of the different types of containers.

Fiberboard and expanded polystyrene foam boxes are not yet sturdy enough to be completely acceptable for marketing fresh grapes. But they offer promise of reducing the cost of packing and shipping grapes. In this study, the costs of packaging and loading materials, direct labor to pack and handle, and the charges for transport amounted to $1.43 for packing and shipping grapes in wood boxes, $1.26 in fiberboard boxes, $1.28 in polystyrene foam boxes, and $1.67 in polyethylene mesh bags in wood boxes. Lower cost of packaging material and less tare weight resulting in lower transport charges were the principal factors accounting for the lower costs of using fiberboard and polystyrene boxes. These lower costs would reflect annual savings in cost of marketing grapes of about $4 million.

No major differences were found, in the limited number of test shipments observed, in the performance of the fiberboard and polystyrene boxes as compared with wood boxes in protecting the grapes from bruising and shattering. The fiberboard boxes did not suffer any damage in transit or during normal handling in the distribution system; but the polystyrene boxes (except those of the 1968 design) did sustain some damage in transit, and they broke when they were handled roughly.

Cooling and warming rates were slower for table grapes packed in polystyrene boxes than for those packed in wood boxes.

Consumer reaction to grapes packaged in polyethylene mesh bags, as measured by sales of grapes in test displays in six supermarkets in San Francisco, was favorable.

INTRODUCTION

Practically all the table grapes sold in the United States are produced in California. The crown-packed wood box, usually packed with 26 pounds of table grapes, has been the most commonly used container for shipping grapes to market. Over the years, shippers made many individual changes in grape shipping containers, with the result that 18 sizes of containers with many variations in container construction and accessory packing materials are now in use for loose-packing grapes. Moreover, the trend toward offering more prepackaged produce for sale in retail stores has led to increased demand from retailers for grapes packaged in consumer-size units.

Rising costs of labor and packaging materials and the need for greater efficiency in the marketing of table grapes pointed toward the need for

research to reappraise the packaging of table grapes in California. Previous research in 1952 showed that prepackaging grapes in cellophane bags in retail stores reduced losses caused by shattering by reducing consumer handling.[1] Investigations published in 1960 on the feasibility of prepackaging grapes in window cartons at shipping point showed that it cost about 50 cents more per box to prepackage them than to pack them loose in wood boxes.[2]

The purpose of this study was to find out (1) how much the cost of marketing table grapes could be reduced if they were packed and shipped in fiberboard or polystyrene foam boxes instead of in wood boxes, (2) how much more it would cost to prepackage grapes in polyethylene mesh bags than to pack them loose in wood boxes, and (3) how consumers would react to buying grapes prepackaged in mesh bags.

DESCRIPTION OF CONTAINERS

The shipping containers tested were wood boxes, fiberboard boxes, and polystyrene foam boxes of two designs. The consumer package tested was a polyethylene mesh bag.

Wood Box

The six-piece nailed wood box had a capacity of 26 pounds of loose-packed grapes (fig. 1 and table 1). A bottom pad, end guards, and display curtain were used in the box.

Fiberboard Box

The fiberboard box tested was a two-piece full-telescope curtain-wax-coated box and had a capacity of 26 pounds of loose-packed grapes (fig. 1). Top and bottom pads and a curtain were used in this box. The box was assembled by stapling. The cover was tightly stapled to the body of the box to hold the fruit firmly in place during transit.

Expanded Polystyrene Foam Boxes

Expanded polystyrene foam box design A was molded in two parts, body and cover, with a density of 1.6 pounds of foam per cubic foot (fig. 1). The panels were approximately 7/8-inch thick, but where ridges were located, 1-inch thick. It held 26 pounds of grapes. The cover was strapped to the body. Accessory packaging materials were not used. Sixteen ventilation holes, representing approximately 0.6 percent of the total surface, were molded in the box.

Expanded polystyrene foam box design B was molded in two parts, body and cover, with a density of 2.25 pounds of foam per cubic foot (fig. 1). The ends of the box were 15/16-inch thick, the sides were 3/4-inch thick, and the top and bottom were 3/8-inch

[1] HAWES, R. L., MCGAHA, M. E., and STOKES, D. R. PREPACKAGING THOMPSON SEEDLESS GRAPES IN CELLOPHANE BAGS IN RETAIL STORES. U.S. Dept. Agr. Prod. and Market. Admin., 8 pp. January 1953. (Mimeo.)

[2] HALE, P. W., and STOKES, D. R. PREPACKAGING CALIFORNIA GRAPES AT SHIPPING POINT. U.S. Dept. Agr., Market. Res. Rpt. 410, 35 pp. 1960.

TABLE 1.—*Tare weight, outside and inside dimensions, volume, and capacity, by type of container*

Item	Wood box	Fiberboard box	Polystyrene foam boxes	
			Design A	Design B
Tare weight pounds	4.00	2.50	0.75	0.75
Outside dimensions inches	[1] 17 5/8 x 14 x 7 1/8	17 x 14 3/8 x 7	18 x 15 3/8 x 8 1/8	17 3/8 x 15 3/8 x 7 1/2
Volume cubic inches	1,758.1	1,710.6	2,248.6	2,003.6
Inside dimensions inches	[1 2] 16 1/8 x 13 1/2 x 6	16 1/8 x 13 1/2 x 6 1/4	16 1/8 x 13 1/2 x 6 3/8	15 5/8 x 14 x 6 3/4
Capacity cubic inches	[3] 1,386	1,360.6	1,387.8	1,476.6

[1] A 5/8-inch top cleat was added to each end, which increased outside depth to 7 3/4 inches and inside depth to 6 5/8 inches when prepackaged grapes were packed in this lug.

[2] Does not include bulge.

[3] Includes allowance for estimated space under crown.

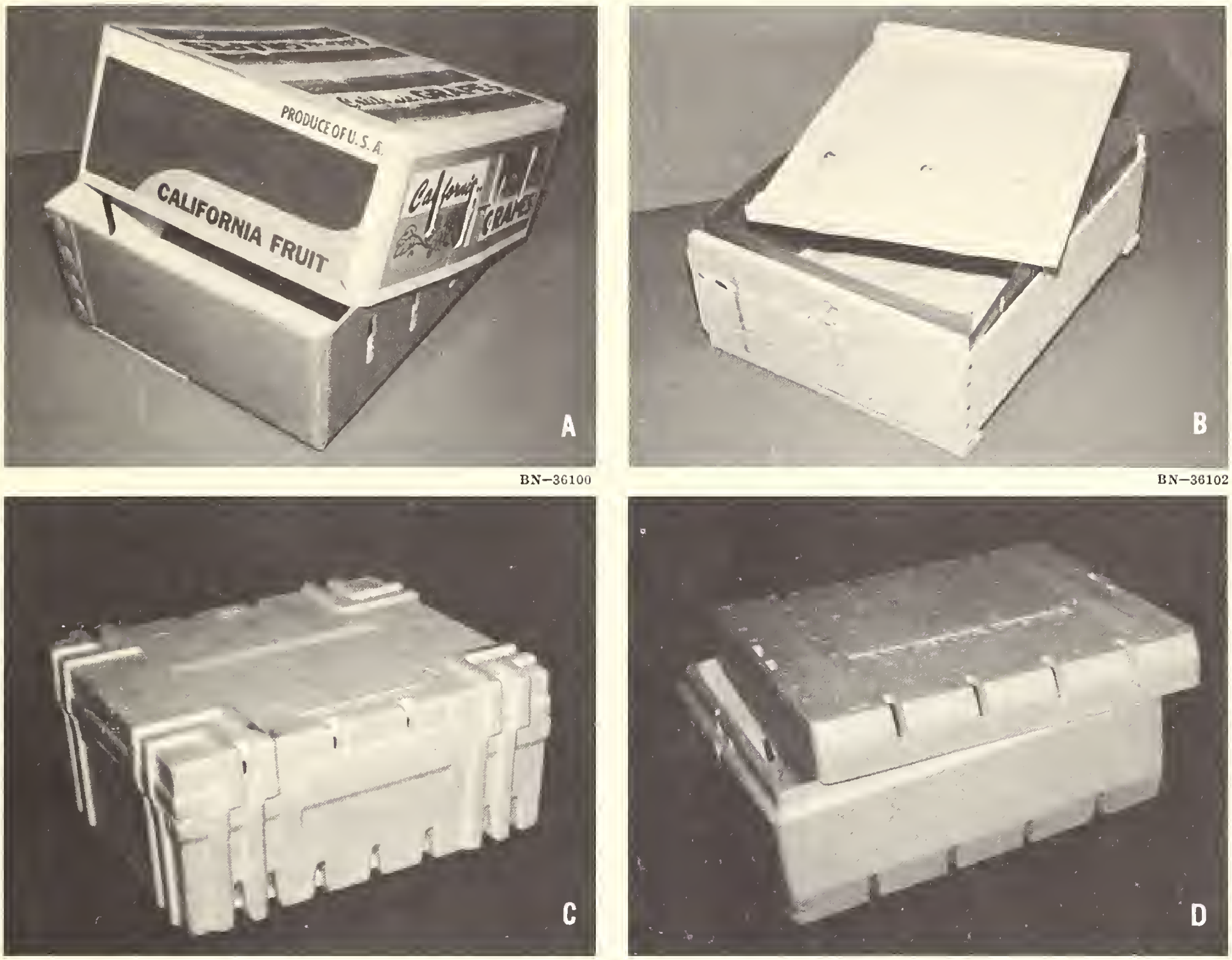

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FIGURE 1.—*A*, 26-pound fiberboard box; *B*, 26-pound wood box; *C*, 26-pound polystyrene box design A; *D*, 26-pound polystyrene box design B.

thick. The capacity was 26 pounds of grapes. The cover snaplocked onto the body. Accessory packaging materials were not used. Twenty ventilation holes, representing approximately 0.8 percent of the total surface, were molded in the box.

Hereafter, the expanded polystyrene foam boxes will be referred to as polystyrene boxes, design A and B.

Polyethylene Mesh Bags

The mesh bags were made of extruded strands of 12-mil polyethylene (fig. 2). The mesh bag was stapled at one end to form the bottom of the bag. Each bag was 16 inches long and had a diameter of

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FIGURE 2.—Polyethylene mesh bag filled with grapes.

5 inches when stretched. The tops of the bags were not closed.

Mesh bags were filled with grapes on a catchweight basis, and 11 to 19, average 16, mesh bags were packed in each wood box. Each wood box held 26 pounds of prepackaged grapes. In 1968, a $\frac{5}{8}$-inch-thick wood cleat was added to each end to increase box depth. All costs and charges are based on the 26-pound pack with the $\frac{5}{8}$-inch cleat added.

PROCEDURE

Packaging-material costs were obtained from manufacturers and suppliers. All packaging-material costs are based on price per thousand units for carlot orders.

Direct labor costs for packing the packages and containers and loading them in railcars were obtained by making time studies in 11 grape packinghouses. Direct labor costs for unloading railcars were obtained by making time studies in eastern terminal markets. A $2-per-hour wage rate was used to calculate packing, loading, and unloading labor costs.

Transport charges were determined by calculating rail and refrigeration charges for shipping table grapes in each type of container from San Joaquin Valley points to the cities included in the U.S. Department of Agriculture market news reports of unloads of fruits and vegetables in the eastern, western, midwestern, and southern areas of the United States.[3] The calculated average transport charges to each of these four areas were weighted by the relative quantities of table grapes shipped to each area.

Costs of equipment, receiving, precooling, storage, supervision, sales, and overhead were not included in this study.

Cost, container damage, and trade reaction data were collected on four truck and one rail shipments of grapes packed in fiberboard boxes; one truck and seven rail shipments of grapes packed in polystyrene box A; two truck and five rail shipments of grapes packed in polystyrene box B; and three truck and three rail shipments of grapes packed in polyethylene mesh bags.

In addition, during the 1968–69 season, two new boxes were designed and tested to determine the feasibility of palletizing grape boxes. In 1968, a 50- by 30-centimeter ($19\frac{11}{16}$ by $11\frac{13}{16}$ inches) polystyrene box was designed for shipment on a 120- by 100-centimeter ($47\frac{1}{4}$ by $39\frac{3}{8}$ inches) pallet. Two carlot shipments of these boxes were made on wood pallets. In 1969, a 20- by 16-inch box of wood and wood veneer laminated with kraft paper was designed for shipment on a 48- by 40-inch pallet. Two shipments—a full railcar and a trailer on flatcar (TOFC)—of these boxes were made on wood pallets.

Bruising studies were made on: two truck test shipments of Thompson Seedless grapes packed in fiberboard boxes and in wood boxes; six rail test shipments of Emperor grapes packed in polystyrene box design A and in wood boxes; two rail test shipments of Thompson Seedless grapes packed in polystyrene box design B and in wood boxes; and three rail test shipments of Thompson Seedless grapes packaged in polyethylene mesh bags and packed loose in wood boxes. All these test shipments were made in refrigerated vehicles. Fruit from the same lot was used in each shipment. Sample boxes of fruit were inspected upon arrival in terminal markets and the amount of shattered (loose) and bruised (flattened, crushed, or split) grapes were recorded. Analysis of variance was used to determine the statistical significance of the data.

The rates of cooling and warming of table grapes packed in polystyrene and wood boxes were studied in a laboratory. The boxes were stacked vertically three high in a refrigerated room at 32° F. for 42 hours. After the grapes cooled to 35°, ambient temperature was increased to 72° for 30 hours. The experiment was replicated four times.

The reaction of consumers to buying grapes prepackaged in polyethylene mesh bags was tested and the amount of shattering from retailing prepackaged and loose grapes was compared in a 3-

[3] United States Department of Agriculture, Federal-State Market News Service. marketing california grapes, raisins, wine, 1966 season. March 1968, 87 pp., San Francisco, Calif.

week study in six San Francisco area supermarkets. Sales from three types of Thompson Seedless grape displays were recorded and compared by a Latin square design. The displays studied were (1) grapes in polyethylene mesh bags; (2) loose grapes; and (3) a combination of loose and packaged grapes. Also the amount of loose (shattered) grapes from each type of display was weighed and recorded. Analysis of variance was used to determine the statistical significance of the data.

COSTS AND CHARGES

Materials and Direct Packing Labor Costs

The costs of packaging materials and direct labor for packing table grapes in specified containers are shown in table 2. These costs were lowest for the fiberboard box and highest for the polyethylene mesh bags in the wood box. The wood box used for the grapes prepackaged in mesh bags were more costly than the wood box used for the loose-packed grapes because of the extra cleats used to increase its depth.

Packers did not have to place accessory packing materials in the polystyrene boxes. The cost of materials and direct labor for prepackaging grapes in mesh bags and packing them in wood boxes was about 24 cents greater than to pack the grapes loose in wood boxes. The cost of the mesh bags and the labor for filling them were chiefly responsible for this higher cost.

Materials and Direct Labor Costs for Loading and Unloading Railcars

The cost of materials and direct labor to load and unload grapes packed and shipped in fiberboard or polystyrene boxes was about 1 cent per box compared with about 5 cents per box for wood boxes (table 3). The fiberboard and polystyrene boxes were loaded solidly in railcars and were braced with mechanical load dividers. Wood fences and center gates were used in the railcars in which

TABLE 2.—*Cost, cents, of packaging materials and direct labor to pack table grapes, by type of container, California, 1968* [1]

Item	Wood box	Fiberboard box	Polystyrene boxes: Design A	Polystyrene boxes: Design B	Polyethylene mesh bags in wood box
Packaging materials:					
Mesh bags					13.8
Shipping containers	41.9	[2] 36.0	[2] 50.0	46.0	45.0
Accessory packaging materials	[3] 7.9	[4] 5.9	[5] 2.2		[3] 7.9
Total materials	49.8	41.9	52.2	46.0	66.7
Direct labor:					
Assemble box	.8	1.2			.8
Make and fill bag					7.0
Pack box	15.2	15.2	14.4	14.4	15.2
Close box	.3	.5	.7	.4	.3
Total labor	16.3	16.9	15.1	14.8	23.3
Total material and labor cost	66.1	58.8	67.3	60.8	90.0

[1] These are direct costs only and do not include costs such as for supervision, overhead, fieldmen, insurance, sales, and equipment.
[2] 1966–67 price; none were manufactured or sold in 1968.
[3] Includes costs of pads, guards, and curtains.
[4] Includes costs of pads.
[5] Includes cost of steel strap and clip.

TABLE 3.—*Cost, cents, of materials and direct labor to load and unload table grapes shipped in railcars, by type of container, California and eastern markets, 1968* [1]

Item	Wood box	Fiberboard box	Polystyrene boxes		Polyethylene mesh bags in wood box
			Design A	Design B	
Loading materials [2]	3.5	0	0	0	3.5
Direct labor:					
Load	.7	.5	.5	.5	.7
Unload	.7	.5	[3] .7	.5	.7
Total	4.9	1.0	1.2	1.0	4.9

[1] These are direct costs only and do not include costs such as for supervision, overhead, insurance, and equipment.

[2] Includes wood fences and center door gate used when loading grapes in wood boxes. Fiberboard boxes and polystyrene foam boxes were solidly loaded in railcars with mechanical load dividers.

[3] More labor was needed to unload design A polystyrene box than design B box, because of the interlocking feature of the design A box that made it difficult to remove the first box from each stack.

TABLE 4.—*Railroad transport charges of table grapes by type of container, from San Joaquin Valley stations, California, to eastern, western, midwestern, and southern markets, 1968*

	Wood box, loose-pack or polyethylene mesh bags	Fiberboard box	Polystyrene boxes A and B
Gross weight pounds [1]	31,200	34,912	31,104
Net weight do	27,040	31,850	29,952
Transport charges: [2]			
Per car: [3]			
Eastern dollars	882.61	970.60	880.33
Western do	420.21	458.09	419.22
Midwestern do	857.79	945.02	855.53
Southern do	854.27	940.69	852.06
Per box:			
Eastern cents	84.8	79.2	76.4
Western do	40.4	37.3	36.3
Midwestern do	82.4	77.1	74.2
Southern do	82.1	76.7	73.9
U.S. weighted average [4] do	72.3	66.3	63.4

[1] Calculated at 30 pounds for the 26-pound wood box (loose and polyethylene mesh bag packs), 29.5 pounds for the 26-pound fiberboard box, and 27 pounds for the 26-pound polystyrene boxes. Usual boxes shipped per car were: 1,040 for 26-pound wood boxes (grapes packed loose or in mesh bags), 1,225 for 26-pound fiberboard boxes, and 1,152 for 26-pound polystyrene boxes. Transport charges from: Transcontinental Freight Bureau, supplement 6 to tariff 44–P, Chicago, Ill. Refrigeration charges from: National Perishable Freight Committee, Perishable Protective Tariff 18, Chicago, Ill.

[2] Freight rates per pound and charges for standard refrigeration were calculated for each type of container to the following cities: (1) eastern—Albany, Baltimore, Boston, Buffalo, New York, Philadelphia, Pittsburgh, Providence, and Washington, D.C.; (2) western—Portland and Seattle; (3) midwestern—Chicago, Cincinnati, Cleveland, Detroit, Indianapolis, Kansas City, Louisville, Milwaukee, Minneapolis, and St. Louis; and (4) southern—Atlanta, Birmingham, Columbia, Houston, Memphis, Miami, Nashville, New Orleans, and San Antonio.

[3] Weighted average rates and charges per car for each of the 4 areas were based on the quantities of table grapes shipped to the above cities during 1964–66 as reported by the Market News Branch, Fruit and Vegetable Division, Consumer and Marketing Service, U.S. Department of Agriculture, 1967.

[4] Average transport charge for the United States was weighted by the quantity of table grapes shipped into each area.

wood boxes were shipped. Mechanical load dividers are not used to brace loads of wood boxes because shippers have found it impractical to squeeze the stacks of boxes and hold them in position.

Transport Charges

Transport charges, per box, for grapes packed and shipped in fiberboard and polystyrene boxes were 66.3 and 63.4 cents, respectively, compared with 72.3 for wood boxes (table 4). Lower costs for the fiberboard and polystyrene boxes are due to the lighter weight of the containers and to a lower per box charge for refrigeration because of the increased number of boxes loaded in railcars.

Total Costs and Charges

The costs of packaging and loading materials, labor to pack, load and unload, and transport charges per box for table grapes are shown in table 5.

These costs were the lowest for the polystyrene box design B, and the highest for the polyethylene mesh bags in the wood box.

Lower packaging-material cost, lower loading and unloading costs, and less tare weight, which resulted in lower transport costs, were the factors accounting for the lower cost of marketing grapes in fiberboard boxes. Less tare weight, which resulted in lower transport costs, was the principal factor accounting for the lower cost of marketing grapes in the polystyrene boxes.

The higher costs for packaging materials and packing labor were the principal factors accounting for the higher cost—24 cents per box—for prepackaging table grapes in polyethylene mesh bags over packing them loose in wood boxes.

Table 5.—*Costs, cents, of packaging and loading materials, packing labor, loading and unloading labor, and transport charges for table grapes, by type of container, California, 1968*

Item	Wood box	Fiberboard box	Polystyrene boxes		Polyethylene mesh bags in wood boxes
			Design A	Design B	
Packaging materials	49.8	41.9	52.2	46.0	66.7
Packing labor	16.3	16.9	15.1	14.8	23.3
Loading and unloading labor and material	4.9	1.0	1.2	1.0	4.9
Transport	72.3	66.3	63.4	63.4	72.3
Total cost per box	143.3	126.1	131.9	125.2	167.2

BRUISING AND SHATTERING OF GRAPES IN TRANSIT

Fiberboard Boxes

Less bruising and less shattering occurred in Thompson Seedless grapes packed and shipped in fiberboard boxes than those in wood boxes in two test shipments made in 1964 (table 6). Two test shipments did not provide a statistically adequate basis for comparing the performance of different containers in protecting grapes from bruising and shattering, but other commercial shipments of grapes did not include comparable grapes packed in fiberboard boxes and in wood boxes.

Polystyrene Boxes

Bruising of Emperor grapes packed and shipped in polystyrene box design A was less, 0.6 percent, than that in wood boxes, 1.1 percent (table 7). This difference in bruising was statistically significant. Shattering was nearly the same—0.4 percent in design A polystyrene box and 0.5 percent in wood boxes.

The difference in bruising and shattering of Thompson Seedless grapes packed in polystyrene box design B and wood boxes was not significant (table 8). However, these data were obtained in only two shipments in which comparable grapes were packed and shipped in the two types of boxes.

Polyethylene Mesh Bags

In three test shipments, bruising of Thompson Seedless grapes that were prepackaged in poly-

ethylene mesh bags and packed in wood boxes averaged 2.7 percent compared with 2.0 percent for comparable grapes packed loose in wood boxes (table 9). Shattering averaged 0.4 percent for the prepackaged grapes and 2.5 percent for the grapes shipped loose in wood boxes.

TABLE 6.—*Percentages of Thompson Seedless grapes bruised and shattered in fiberboard boxes and in wood boxes, 2 truck shipments from California to midwestern terminal markets, 1964*

Type of injury and shipment No.	Fiberboard box	Wood box
Bruised:		
1	1.6	3.8
2	3.0	3.4
Average	2.3	3.6
Shattered:		
1	4.1	4.4
2	3.5	4.0
Average	3.8	4.2

TABLE 7.—*Percentages of Emperor grapes bruised and shattered in polystyrene foam box design A and in wood boxes, 6 rail shipments from California to eastern terminal markets, 1965*

Type of injury and shipment No.	Polystyrene box design A	Wood box
Bruised:		
1	0.4	0.6
2	.8	1.0
3	.5	.9
4	.5	1.3
5	.7	2.0
6	.7	1.1
Average [1]	.6	1.1
Shattered:		
1	.4	1.0
2	.4	.4
3	.3	.2
4	.6	.6
5	.3	.4
6	.5	.5
Average	.4	.5

[1] Difference in bruising between the type of containers was statistically significant at the 5-percent level.

TABLE 8.—*Percentages of Thompson Seedless grapes bruised and shattered in polystyrene foam box design B and in wood boxes, 2 rail shipments from California to eastern terminal markets, 1966*

Type of injury and shipment No.	Polystyrene box design B	Wood box
Bruised:		
1	1.2	1.3
2	3.0	4.5
Average	2.1	2.9
Shattered:		
1	3.1	2.9
2	2.3	3.5
Average	2.7	3.2

TABLE 9.—*Percentages of bruised and shattered Thompson Seedless grapes prepackaged in polyethylene mesh bags and loose packed in wood boxes, 3 rail shipments from California to eastern terminal markets, 1965*

Type of injury and shipment No.	Prepackaged polyethylene mesh bags packed in wood boxes	Wood boxes loose pack
Bruised:		
1	1.8	1.5
2	4.9	3.1
3	1.3	1.5
Average	2.7	2.0
Shattered:		
1	.3	2.1
2	.4	2.3
3	.5	3.1
Average [1]	.4	2.5

[1] Difference between the types of packages was statistically significant at the 5-percent level.

CONTAINER DAMAGE

In the four truck and one rail test shipments, the fiberboard boxes arrived at terminal markets without damage.

The polystyrene boxes were easily damaged by rough handling or by shifting in the truck or railcars in transit. In the three truck and 12 rail test shipments, 0.5 percent of the polystyrene boxes were slightly damaged and 1.5 percent were seriously damaged. Slightly damaged boxes were chipped but were still usable. Seriously damaged boxes were broken or crushed and were unusable. Some shipments arrived with very little damage to the boxes, and others, particularly those in which the loads were not properly braced, arrived with extensive damage.

The palletized shipments of the polystyrene boxes of the 1968 design (p. 4) arrived at terminal markets without damage to the containers (fig. 3, *A*). Likewise, the palletized shipments of the wood and wood veneer laminated with kraft paper boxes (p. 4) sustained no container damage (fig. 3, *B*).

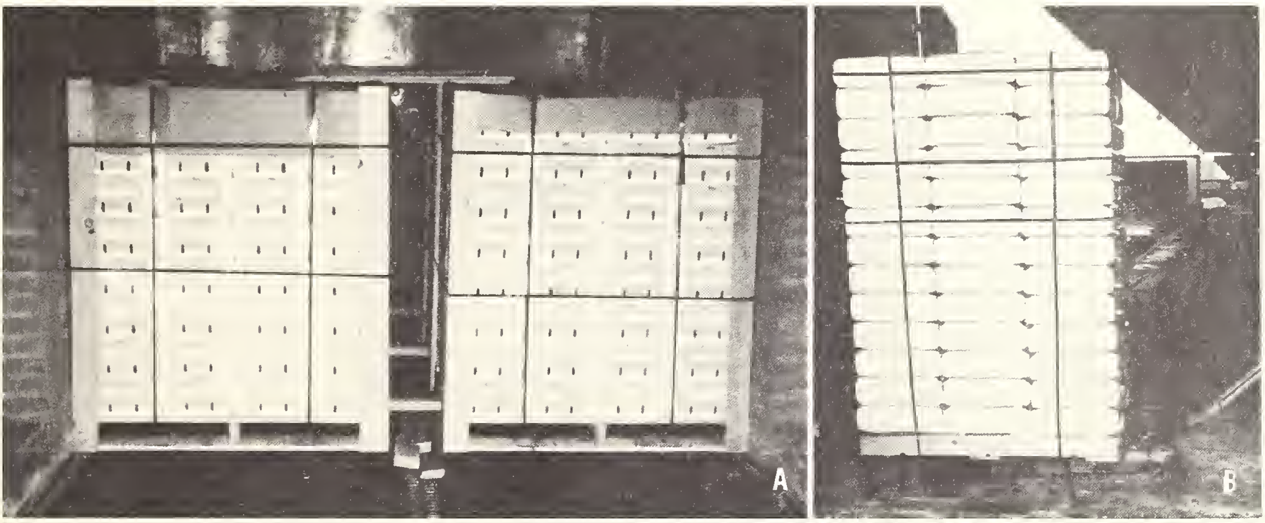

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FIGURE 3.—Arrival condition of grapes at eastern terminal markets: *A*, in 50- by 30-centimeter polystyrene boxes on 120- by 100-centimeter pallets; and *B*, in 20- by 16-inch boxes of wood and wood veneer laminated with kraft paper on a 48- by 40-inch pallet.

COOLING GRAPES IN POLYSTYRENE BOXES

Cooling and warming rates were slower for table grapes packed in polystyrene boxes than for those packed in wood boxes (fig. 4). It required 23 hours for grapes packed in wood boxes to cool from 70° to 32° F. and 33 hours for the grapes packed in polystyrene boxes. Therefore, attention needs to be given to the number and placement of ventilation holes in polystyrene boxes and to stacking arrangements of the boxes in storage or in refrigerated vehicles. Conversely, the polystyrene boxes protect the grapes better from warming up when exposed to higher temperatures, which frequently happens during distribution; that is, in wholesale stores, delivery vehicles, or in retail stores.

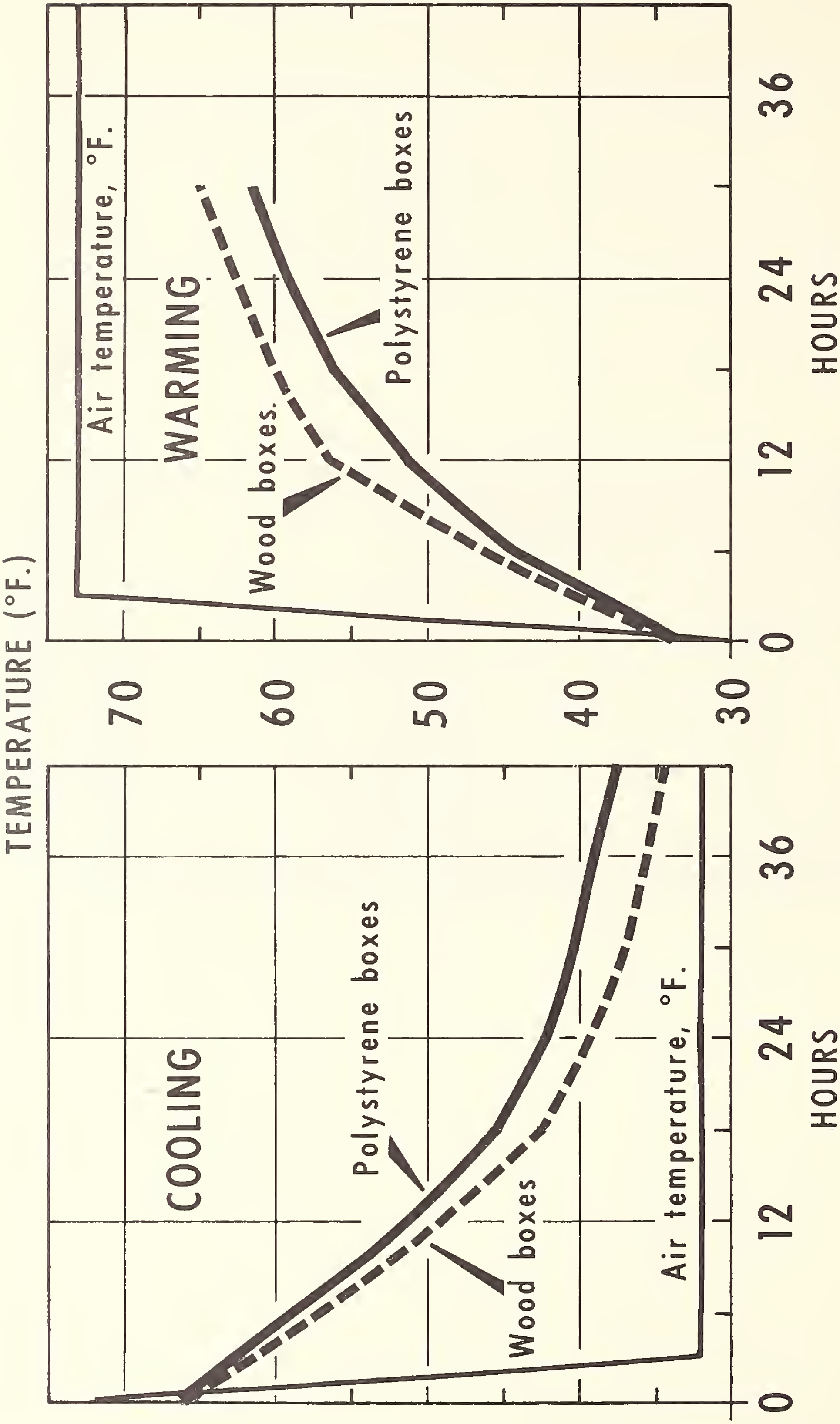

FIGURE 4.—Comparison of rate of cooling and warming of table grapes in polystyrene boxes and wood boxes.

POLYETHYLENE MESH BAG GRAPE SALES AND SHATTERING LOSSES

Consumer Reaction to Grapes Packaged in Polyethylene Mesh Bags

In the study in the six San Francisco area supermarkets, no unusual customer behavior was detected. Usually the customers picked up the packages without question, but occasionally customers opened the bags (which were not sealed) and examined the grapes before rejecting them or placing them in the shopping cart. An unforeseen special sale of Tokay grapes during the second week reduced Thompson Seedless grape sales during that week by about one-third. Average store sales by type of display were as follows:

Average sales [1]—pounds

Prepackaged	478
Bulk	371
Combination prepackaged and bulk	634

[1] Differences between each of the display types are statistically significant at the 5-percent level.

In three stores, table grapes that were displayed prepackaged outsold those that were displayed in bulk. Analysis of the data for all stores indicated a statistically significant increase in sales when grapes were sold prepackaged. A greater increase occurred when grapes were sold in the combination display. However, the display area used for the combination display was 50-percent larger than the display area used for the display of single treatments.

Grape Shattering Losses in Retail Stores

In the study in six San Francisco supermarkets, the amount of shattered grapes, as a percentage of the quantity of grapes handled in the stores, were: displayed loose 6.7 percent, displayed in polyethylene mesh bags 0.7 percent, and displayed loose and in polyethylene mesh bags 3.5 percent (1.1 percent of the prepackaged and 5.9 percent of the loose grapes). All the grapes that were shattered from bunches in the bulk displays were recorded as waste. An unknown quantity of loose grapes remained in the mesh bags that were purchased by the customers.

ADVANTAGES AND DISADVANTAGES OF FIBERBOARD BOXES, POLYSTYRENE BOXES, AND POLYETHYLENE MESH BAGS

The advantages and disadvantages of packing and shipping table grapes in fiberboard boxes, polystyrene boxes, and polyethylene mesh bags, based on data obtained in this study and on opinions of grape shippers, wholesalers, and retailers who packed and shipped or distributed the grapes, are summarized below.

Fiberboard Boxes

Advantages:

1. Cheaper than wood boxes.
2. Less shattered and bruised grapes in transit than in wood boxes.
3. Easy to handle.
4. Reduced tare weight reduces transport expense.

Disadvantages:

1. Pallet racks, or pallet supports, are needed to protect fiberboard boxes on lower pallets in storage.
2. The wax-coated fiberboard is slippery and hard to handle.
3. Unsuitable for moving by hand clamp trucks.

Polystyrene Boxes

Advantages:

1. Cheaper than wood boxes.

2. Nice bright, white appearance.
3. Reduced tare weight reduces transport expense.
4. Easy to handle and stack.
5. Easily palletized.
6. Grapes in polystyrene boxes heat up less rapidly than in wood boxes.

Disadvantages:

1. Easily damaged when not loaded or handled carefully.
2. Unsuitable for moving by hand clamp trucks.
3. Extraordinary care is needed to open and close the locking device on polystyrene box B. However, this locking device was preferred by receivers over the metal strap used on polystyrene box A.
4. Grapes cool more slowly in polystyrene boxes than wood boxes.
5. High inventory cost.

Polyethylene Mesh Bags

Advantages:

1. Less retail labor required to display grapes in mesh bags than loose-packed grapes.
2. Grape shippers can brand identification.
3. Adequate ventilation provided.
4. All the grapes can be seen by the consumer.
5. Loose grapes are kept off the retailer's floor; thus, accidents are prevented.
6. Less shattering losses than with loose-packed grapes.

Disadvantages:

1. Packing costs are more; thus, a premium price has to be charged.
2. Grapes may be damaged by mesh bag. Bruised and discolored grapes are very noticeable and difficult to remove from the bag.
3. More packinghouse labor required to pack the bags.
4. Packing operations slowed down during peak packing season.

DISCUSSION

Investigations of shipping containers indicate that the costs of marketing California table grapes could be reduced by using less costly shipping containers. Fiberboard boxes show promise but improvement in them is needed to make them suitable, especially in high-humidity refrigerated storage for a long time. Improvements are also needed to make polystyrene boxes sturdy enough to prevent breakage during transport and in distribution channels under normal handling conditions.

If these improvements could be made, large annual savings from marketing grapes in fiberboard or polystyrene boxes could be realized.

It was estimated that in 1969 about 46 percent of produce was prepackaged before delivery to retail stores.[4]

If grapes are going to be retailed in consumer packages, the question of whether the grapes should first be loose packed in the shipping container and then shipped to the retailer where they are unpacked and repackaged in retail-size packages or whether they should be prepackaged in the production areas needs further investigation. When the cost of prepackaging is shifted from the retailer back to the packer at shipping point, the packer faces the difficult task of recapturing the added cost. Grape packers who have tried consumer packaging have complained about the difficulty of obtaining a price high enough to recompense them for the additional cost. As pointed out in this study, there are other costs in addition to packaging materials and packing labor that occur when grape shippers prepackage grapes at point of production.

[4] Stokes, D. R. Produce packaging—past, present, and future. U.S. Dept. Agr., Agr. Res. Serv. 4 pp. October 1969. (Mimeo.)

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